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EXAMINER	
WONG, EDNA	

ART UNIT	PAPER NUMBER
1753	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/624,564	HIRAO, SHUJI	
	Examiner	Art Unit	
	Edna Wong	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11 and 31-36* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11 and 31-36* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

This is in response to the Amendment dated August 9, 2000. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Drawings

Figure **9** should be designated by a legend such as --Prior Art-- because only that which is old is illustrated.

The objection to the drawings has been withdrawn in view of Applicant's amendment.

Specification

The disclosure has been objected to because of minor informalities.

The objection of the disclosure has been withdrawn in view of Applicant's amendment.

Claim Rejections - 35 USC § 112

I. Claims **1-11** have been rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for electroplating, does not reasonably provide enablement for chemical vapor deposition, physical vapor deposition and electroless plating. The specification does not enable any person skilled in the art to which it

pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

The rejection of claims 1-11 under 35 U.S.C. 112, first paragraph, has been withdrawn in view of Applicant's amendment.

II. Claims **1-11** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 1-11 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicant's amendment.

Claim Rejections - 35 USC § 102

Claims **1 and 3-5** have been rejected under 35 U.S.C. 102(b) as being anticipated by **JP 2001-316869** ('869).

The rejection of claims 1 and 3-5 under 35 U.S.C. 102(b) as being anticipated by JP 2001-316869 ('869) has been withdrawn in view of Applicant's remarks.

Claim Rejections - 35 USC § 103

I. Claims **2 and 11** are rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Reid et al.** (US Patent No. 6,551,487 B1).

The rejection of claims 2 and 11 under 35 U.S.C. 103(a) as being unpatentable over JP 2001-316869 ('869) as applied to claims 1 and 3-5 above, and further in view of Reid et al. has been withdrawn in view of Applicant's remarks.

II. Claims **6 and 9-10** are is rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of Applicant's admitted prior art (specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; and Figs. 10A-10B and 13A-13B).

The rejection of claims 6 and 9-10 under 35 U.S.C. 103(a) as being unpatentable over JP 2001-316869 ('869) as applied to claims 1 and 3-5 above, and further in view of Applicant's admitted prior art has been withdrawn in view of Applicant's remarks.

III. Claim **7** is rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Batz, Jr. et al.** (US Patent No. 6,001,234).

The rejection of claim 7 under 35 U.S.C. 103(a) as being unpatentable over JP 2001-316869 ('869) as applied to claims 1 and 3-5 above, and further in view of Batz, Jr. et al. has been withdrawn in view of Applicant's remarks.

IV. Claim **8** is rejected under 35 U.S.C. 103(a) as being unpatentable over **JP 2001-316869** ('869) as applied to claims 1 and 3-5 above, and further in view of **Wang et al.**

(US Patent No. 6,610,189 B2).

The rejection of claim 8 under 35 U.S.C. 103(a) as being unpatentable over **JP** 2001-316869 ('869) as applied to claims 1 and 3-5 above, and further in view of Wang et al. has been withdrawn in view of Applicant's remarks.

Response to Amendment

Drawings

The drawings were received on August 9, 2006. These drawings are approved by the Examiner.

Claim Rejections - 35 USC § 102/103

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

I. Claims **1 and 3-6** are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B).

Grandikota teaches a method for plating a substrate comprising the steps of:

(a) rotating the substrate in a plating solution at a first speed of rotation (= between *about 20 rpm and about 50 rpm*); and

(b) rotating the substrate in the plating solution at a second speed of rotation (= between *about 3 rpm and about 30 rpm*) lower than the first speed of rotation and thereby performing an electrolytic plating process with respect to the substrate (page 3 [0025]),

wherein the electrolytic plating process is performed with a surface of the substrate to be plated faced downward and the substrate immersed in the plating solution (page 2, [0017]; and Fig. 1).

The second speed of rotation is not less than 10 rpm and not more than 60 rpm (= between about 3 rpm and about 30 rpm) [page 3, [0025]].

A current density applied to the substrate in the step of rotating is lower than a current density applied to the substrate in the step of performing the electrolytic plating process with respect to the substrate (= from the substrate loading bias from about -0.8V to about -10 V applied to the substrate plating surface *while the substrate is being immersed in the plating solution*) [page 3, [0024]].

The method further comprises, prior to the step of rotating, the step of forming a seed layer on the surface of the substrate to be plated (= a PVD Cu seed layer) [page 3, [0021]], wherein the step of rotating includes the step of preventing the seed layer from being dissolved in the plating solution (= the loading bias not only *circumvents seed layer dissolution* but also provides polarization of organic molecules conductive for superfill) [page 3, [0024]].

The substrate is held in the plating solution by a substrate holding mechanism **220** (= head assembly) having an electrode for contacting the surface to be plated (page 3, [0017]; and Fig. 1).

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Wherein the rotation of the substrate in the plating solution at the first speed of rotation removes a bubble adsorbed to the substrate, as recited in claim 1.

Grandikota teaches that to further enhance plating, the substrate is rotated upon immersion into the plating solution between about 20 rpm and about 50 rpm (page 3, [0025]).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because Grandikota discloses rotating the substrate in the plating solution at the first speed of rotation in a similar manner as instantly claimed. Therefore, it would have been within the skill of the art to expect that

the rotation disclosed by Grandikota would have removed a bubble adsorbed to the substrate.

b. Wherein the bubble has a size of 10 μm or less, as recited in claim 6.

Applicant discloses that when the semiconductor substrate is brought into contact with the plating solution, extremely small bubbles each having a size of about *several micrometers or less* are adsorbed to the surface to be plated (specification, page 2, lines 6-8).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because when the semiconductor substrate is brought into contact with the plating solution, extremely small bubbles each having a size of about several micrometers or less are adsorbed to the surface to be plated as taught Applicant (specification, page 2, lines 6-8).

II. Claim **36** is rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B).

Grandikota and Applicant's Admitted Prior Art are as applied for reasons as discussed above and incorporated herein.

Claim Rejections - 35 USC § 103

I. Claims **2 and 9-11** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B) as applied to claims 1 and 3-6 above, and further in view of **Reid et al.** (US Patent No. 6,551,487 B1).

Grandikota and Applicant's Admitted Prior Art are as applied above and incorporated herein.

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Wherein the first speed of rotation is not less than 100 rpm and not more than 200 rpm, as recited in claim 2.

b. Prior to the step of removing the bubble, immersing the substrate in the plating solution, while rotating the substrate at the first speed of rotation or at a third speed of rotation higher than the second speed of rotation, as recited in claim 11.

Grandikota teaches that to further enhance plating, the substrate is rotated upon immersion into the plating solution between about 20 rpm and about 50 rpm (page 3, [0025]).

Like Grandikota, Reid teaches a method for plating a substrate performed with respect to the substrate **240** (= wafer) by facing a surface of the substrate to be plated

downward and immersing the substrate in a plating solution **244** (= electrolyte) [col. 9, lines 11-18; and Fig. 2E]. The substrate **240** is immersed in the plating solution **244**, while rotating the substrate at the first speed of rotation (= between about 1 and 150 rpm) [col. 8, line 66 to col. 9, line 18; and Figs. 2D-2E]. For a 300 mm diameter wafer, the speed is preferably between about 50 and 100 rpm (col. 6, lines 35-50; and col. 8, line 66 to col. 9, line 10).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the first speed of rotation described by Grandikota with wherein the first speed of rotation is not less than 100 rpm and not more than 200 rpm; and prior to the step of removing the bubble, immersing the substrate in the plating solution, while rotating the substrate at the first speed of rotation or at a third speed of rotation higher than the second speed of rotation because if wafer rotation and immersion rate (z speed) are properly controlled, multiple wetting fronts and bubble formation (frothing) during immersion would have been minimized as taught by Reid (col. 8, line 66 to col. 9, line 10).

Furthermore, the first speed of rotation is a result-effective variable and one skilled in the art has the skill to calculate the first speed of rotation that would have determined the success of the desired reaction to occur, e.g., depending on the operation and the diameter of the substrate (MPEP § 2141.03 and § 2144.05(II)(B)).

c. Prior to the step of removing the bubble, performing an electrolytic plating

process with respect to the substrate in a plating solution until at least the one of depressed portions provided in the surface to be plated having a minimum diameter is filled up, as recited in claim 9.

Applicant discloses that the residues of the TaN film **59a** and the Cu film **59b** resulting from the polishing of wiring material are filled also in the depression **57** to form a conductive portion **59** (specification, page 3, line 24 to page 4, line 1).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because a depression resulting from a pit defect or the like are conventionally encountered in the art and the residues of a TaN film and a Cu film resulting from the polishing of wiring material are filled also in the depression to form a conductive portion as taught by Applicant (specification, page 3, line 24 to page 4, line 1).

d. Wherein a thickness of a plate film necessary to fill up the depressed portion having the minimum diameter is 20% or less of a target thickness of the plate film, as recited in claim 10.

Applicant shows a depression **57** smaller than the trench below it (Fig. 13B).

The invention as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made because since the depression is smaller than the trench, the thickness of a plate film necessary to fill up the depressed portion having the minimum diameter would have been 20% or less of a target thickness of the plate

film, depending upon how much smaller the depression was from the trench.

II. Claim **7** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B) as applied to claims 1 and 3-6 above, and further in view of **Batz, Jr. et al.** (US Patent No. 6,001,234).

Grandikota and Applicant's Admitted Prior Art are as applied above and incorporated herein.

The method of Grandikota differs from the instant invention because Grandikota does not disclose wherein the substrate holding mechanism has a seal for contacting the surface to be plated in such a manner as to protect the electrode from the plating solution and a contact angle of the seal relative to the surface to be plated is not less than 120° and not more than 150°, as recited in claim 7.

Grandikota teaches *a head assembly* **210** (Fig. 1).

Grandikota teaches that the plating process may be carried out on the *Electra ECP system*, which is commercially available from Applied Materials, Inc., of Santa Clara, Calif. (page 3, [0022]).

Like Grandikota, Batz, Jr. teaches a method for electroplating a substrate faced downward in the plating solution.

Batz, Jr. teaches a processing head having a finger assembly (col. 19, lines 7-27). Batz, Jr. teaches a seal **868** for contacting the surface **W** to be plated in such a manner as to protect the electrode **858** from the plating solution (col. 22, line 65 to col. 23, line 41; and Fig. 22).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the head assembly described by Grandikota with wherein the substrate holding mechanism has a seal for contacting the surface to be plated in such a manner as to protect the electrode from the plating solution and a contact angle of the seal relative to the surface to be plated is not less than 120° and not more than 150° because the selection of old parts to operate in new environments in order to achieve the same results was held to have been obvious. *In re Ross* 105 USPQ 237. And the substitution of known equivalent structures was held to have been obvious. *In re Ruff* 118 USPQ 343 (CCPA 1958).

III. Claim **8** is rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B) as applied to claims 1 and 3-6 above, and further in view of **Wang et al.** (US Patent No. 6,610,189 B2).

Grandikota and Applicant's Admitted Prior Art are as applied above and

incorporated herein.

The method of Grandikota differs from the instant invention because Grandikota does not disclose wherein the step of removing the bubble includes the step of applying supersonic vibration to the plating solution, as recited in claim 8.

Like Grandikota, Wang teaches a method for electroplating a substrate faced downward in the plating solution. Wang teaches that mechanically vibrating the electrolyte solution mechanically enhances the concentration of metal ions in the electrolyte solution in the features (col. 13, line 62 to col. 14, line 19).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the step of removing the bubble described by Grandikota with wherein the step of removing the bubble includes the step of applying supersonic vibration to the plating solution because this would have mechanically enhances the concentration of metal ions in the electrolyte solution in the features as taught by Wang (col. 13, line 62 to col. 14, line 19).

Furthermore, the reason or motivation to modify the reference may often suggest what the inventor has done, but for a different purpose or to solve a different problem. It is not necessary that the prior art suggest the combination to achieve the same advantage or result discovered by the Applicants. *In re Linter* 458 F.2d 1013, 173 USPQ 560 (CCPA 1972); *In re Dillon* 919 F.2d 688, 16 USPQ2d 1897 (Fed. Cir. 1990), *cert. denied*, 500 US 904 (1991); and MPEP § 2144.

IV. Claims **31-35** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in view of **Applicant's Admitted Prior Art** (Specification, "Background of the Invention", page 2, lines 6-12; page 3, line 10 to page 4, line 4; Figs. 10A-10B and 13A-13B) as applied to claims 1 and 3-6 above, and further in view of **Bran** (US Patent No. 6,140,744).

Grandikota and Applicant's Admitted Prior Art are as applied above and incorporated herein.

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Prior to the step of removing the bubble, the step of: improving a wettability of the surface to be plated before immersing the substrate in the plating solution, as recited in claim 31.

b. Wherein the step of improving the wettability includes the step of supplying a liquid to the surface to be plated, as recited in claim 32.

c. Wherein the step of improving the wettability includes the step of removing a particle adhered to the surface to be plated, as recited in claim 33.

d. Wherein the step of removing the particle includes the step of applying supersonic vibration to the surface to be plated, as recited in claim 34.

e. Wherein the step of removing the particle includes the step of supplying a liquid to which supersonic vibration has been applied to the surface to be plated, as recited in claim 35.

Like Grandikota, Bran teaches semiconductor wafers. Bran teaches that semiconductor wafers are frequently cleaned in *a cleaning solution* into which *megasonic energy* is propagated. The agitation of the cleaning fluid produced by the megasonic energy loosens particles on the semiconductor wafer. Contaminants are vibrated away from the surfaces of the wafer (col. 1, lines 14-31).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota with a-e above because the agitation of a cleaning fluid produced by megasonic energy would have loosened particles on a semiconductor wafer and contaminants would have been vibrated away from the surfaces of the wafer as taught by Bran (col. 1, lines 14-31).

As to improving the wettability, a cleaned surface would have naturally improved the wettability of the surface.

Furthermore, the reason or motivation to modify the reference may often suggest what the inventor has done, but for a different purpose or to solve a different problem. It is not necessary that the prior art suggest the combination to achieve the same advantage or result discovered by the Applicants. *In re Linter* 458 F.2d 1013, 173 USPQ 560 (CCPA 1972); *In re Dillon* 919 F.2d 688, 16 USPQ2d 1897 (Fed. Cir. 1990), *cert. denied*, 500 US 904 (1991); and MPEP § 2144.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-

1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Edna Wong
Primary Examiner
Art Unit 1753

EW
September 23, 2006